Claims

1. (Currently Amended) In a computer system, a method of ~~processing~~ decoding images in a sequence of video images, the method comprising:

~~determining~~ receiving and decoding a code in a bit stream to determine a fraction for a current image in the sequence, wherein the fraction represents ~~an estimated~~ a selected temporal distance position for the current image relative to an interval between a first reference image for the current image and a second reference image for the current image, and wherein the determination of the fraction is independent of actual temporal distance positions of the respective reference images; ~~and~~

processing the fraction along with a motion vector for the first reference image, wherein the motion vector represents motion in the first reference image relative to [[a]] the second reference image for the current image~~, and wherein the processing the fraction along with the motion vector results in a representation of motion in the current image relative to the first reference image~~; and

using the fraction and the motion vector in motion compensation for the current image.

2. (Currently Amended) The method of claim 1 wherein the ~~fraction is represented by~~ code comprises a variable length code ~~in a bit stream~~.

3. (Currently Amended) The method of claim 1 wherein the fraction is selected from a set of discrete values, wherein each of the values ~~are~~ is greater than zero and less than one so as to indicate the selected temporal distance position within the interval.

4. (Original) The method of claim 1 wherein the fraction is selected from the group consisting of: 1/2, 1/3, 2/3, 1/4, 3/4, 1/5, 2/5, 3/5, 4/5, 1/6, 5/6, 1/7, 2/7, and 3/7.

5. (Currently Amended) The method of claim 1 wherein the ~~estimated~~ selected temporal distance position for the current image relative to the interval between the first reference image for the current image and the second reference image for the current image is not ~~the~~ a true temporal distance position of the current image within the interval.

6. (Original) The method of claim 1 wherein the fraction is based on motion information for the sequence of video images.

7. (Original) The method of claim 1 wherein the fraction is based on a proximity of the current image to an end of the sequence of video images.

8.-9. (Canceled)

10. (Currently Amended) The method of claim 1 further comprising repeating the acts of claim 1 for each of plural bi-directionally predicted images in the sequence of video images.

11.-17. (Canceled)

18. (Currently Amended) In a computer system, a method of encoding images in a sequence of video images, the method comprising:

~~determining~~ selecting a fraction for a current image in the sequence, wherein the current image has a previous reference image and a future reference image, ~~and~~ wherein the fraction represents a selected temporal position for the current image relative to ~~its~~ the respective reference images, and wherein the selecting of the fraction is independent of actual temporal positions of the respective reference images;

selecting direct mode prediction for ~~a current~~ one or more macroblocks in the current image;

finding a motion vector for a co-located macroblock in the future reference image[[;]], wherein the fraction facilitates scaling the motion vector for the co-located macroblock in direct mode prediction ~~using the fraction~~; and

using results of the scaling in motion compensation for the current image.

19. (Original) The method of claim 18 wherein the fraction facilitates representation of variable velocity motion in the direct mode prediction.

20. (Currently Amended) The method of claim 18 wherein the scaling the motion vector for the co-located macroblock comprises scaling ~~the~~ <u>a</u> vertical component and <u>a</u> horizontal component[[s]] of the motion vector for the co-located macroblock.

21. (Currently Amended) The method of claim 18 wherein the scaling the motion vector for the co-located macroblock comprises:

scaling the motion vector for the co-located macroblock by a factor of the fraction, to obtain an implied forward motion vector for ~~the~~ <u>a</u> current macroblock <u>of the one or more macroblocks;</u> and

scaling the motion vector for the co-located macroblock by a factor of the fraction minus one, to obtain an implied backward motion vector for the current macroblock<u>, wherein for the current macroblock the motion compensation uses the implied forward motion vector and the implied backward motion vector</u>.

22.-73. (Canceled)

74. (New) The method of claim 2 wherein the determination of the fraction comprises looking up the variable length code in a variable length code table to obtain a value for the fraction.

75. (New) The method of claim 74 wherein at least one entry in the variable length code table represents a frame type, and wherein the frame type is B/I-frame.

76. (New) One or more computer-readable storage media having stored thereon computer-executable instructions for causing one or more computers to perform a method of decoding images in a sequence of video images, the method comprising:

receiving and decoding a code in a bit stream to determine a fraction for a current image in the sequence, wherein the fraction represents a selected temporal distance position for the current image relative to an interval between a first reference image for the current image and a second reference image for the current image, and wherein the determination of the fraction is independent of actual temporal distance positions of the respective reference images; and

processing the fraction along with a motion vector for the first reference image, wherein the motion vector represents motion in the first reference image relative to the second reference image for the current image.

77. (New) The computer-readable storage media of claim 76 wherein the code comprises a variable length code.

78. (New) The computer-readable storage media of claim 76 wherein the fraction is selected from a set of discrete values, wherein each of the values is greater than zero and less than one so as to indicate the estimated temporal distance position within the interval.

79. (New) The computer-readable storage media of claim 76 wherein the fraction is selected from the group consisting of: 1/2, 1/3, 2/3, 1/4, 3/4, 1/5, 2/5, 3/5, 4/5, 1/6, 5/6, 1/7, 2/7, and 3/7.

80. (New) The computer-readable storage media of claim 76 wherein the selected temporal distance position for the current image relative to the interval between the first reference image for the current image and the second reference image for the current image is not a true temporal distance position of the current image within the interval.

81. (New) The computer-readable storage media of claim 76 wherein the fraction is based on motion information for the sequence of video images.

82. (New) The computer-readable storage media of claim 76 wherein the fraction is based on a proximity of the current image to an end of the sequence of video images.

83. (New) The computer-readable storage media of claim 76 wherein the determination of the fraction comprises looking up the code in a code table to obtain a value for the fraction.

84. (New) The computer-readable storage media of claim 83 wherein at least one entry in the variable length code table represents a frame type, and wherein the frame type is B/I-frame.

85. (New) A method of encoding images in a sequence of video images, the method comprising:

selecting a fraction for a current image in the sequence, wherein the fraction represents a selected temporal distance position for the current image relative to an interval between a first reference image for the current image and a second reference image for the current image, and wherein definition of the fraction is independent of actual temporal distance positions of the respective reference images; and

outputting a code that represents the fraction in a bit stream.

86. (New) The method of claim 85 wherein the code comprises a variable length code.

87. (New) The method of claim 85 wherein the fraction is selected from a set of discrete values, wherein each of the values is greater than zero and less than one so as to indicate the selected temporal distance position within the interval.

88. (New) The method of claim 85 wherein the fraction is selected from the group consisting of: 1/2, 1/3, 2/3, 1/4, 3/4, 1/5, 2/5, 3/5, 4/5, 1/6, 5/6, 1/7, 2/7, and 3/7.

89. (New) The method of claim 85 wherein the selected temporal distance position for the current image relative to the interval between the first reference image for the current image and the second reference image for the current image is not a true temporal distance position of the current image within the interval.

90. (New) The method of claim 85 wherein the fraction is based on motion information for the sequence of video images.

91. (New) The method of claim 85 wherein the fraction is based on a proximity of the current image to an end of the sequence of video images.

92. (New) The method of claim 85 wherein the code comprises a variable length code in a variable length code table.

93. (New) The method of claim 92 wherein at least one entry in the variable length code table represents a frame type, and wherein the frame type is B/I-frame.

94. (New) The method of claim 85 wherein the selecting the fraction comprises:

evaluating each of plural fractions to determine bit costs for encoding the current image using the respective fractions; and

selecting the fraction based on the evaluating.

95. (New) One or more computer-readable storage media having stored thereon computer-executable instructions for causing one or more computers to perform a method of encoding images in a sequence of video images, the method comprising:

selecting a fraction for a current image in the sequence, wherein the fraction represents a selected temporal distance position for the current image relative to an interval between a first reference image for the current image and a second reference image for the current image, and wherein the selecting of the fraction can be independent of actual temporal distance positions of the respective reference images; and

outputting a code that represents the fraction in a bit stream.

96. (New) The computer-readable storage media of claim 95 wherein the code comprises a variable length code.

97. (New) The computer-readable storage media of claim 95 wherein the fraction is selected from a set of discrete values, wherein each of the values is greater than zero and less than one so as to indicate the selected temporal distance position within the interval.

98. (New) The computer-readable storage media of claim 95 wherein the fraction is selected from the group consisting of: 1/2, 1/3, 2/3, 1/4, 3/4, 1/5, 2/5, 3/5, 4/5, 1/6, 5/6, 1/7, 2/7, and 3/7.

99. (New) The computer-readable storage media of claim 95 wherein the selected temporal distance position for the current image relative to the interval between the first reference image for the current image and the second reference image for the current image is not a true temporal distance position of the current image within the interval.

100. (New) The computer-readable storage media of claim 95 wherein the fraction is based on motion information for the sequence of video images.

101. (New) The computer-readable storage media of claim 95 wherein the fraction is based on a proximity of the current image to an end of the sequence of video images.

102. (New) The computer-readable storage media of claim 95 wherein the code comprises a variable length code in a variable length code table.

103. (New) The computer-readable storage media of claim 102 wherein at least one entry in the variable length code table represents a frame type, and wherein the frame type is B/I-frame.

104. (New) The computer-readable storage media of claim 95 wherein the selecting the fraction comprises:

evaluating each of plural fractions to determine bit costs for encoding the current image using the respective fractions; and

selecting the fraction based on the evaluating.

105. (New) One or more computer-readable storage media having stored thereon computer-executable instructions for causing one or more computers to perform a method of encoding images in a sequence of video images, the method comprising:

selecting a fraction for a current image in the sequence, wherein the current image has a previous reference image and a future reference image, wherein the fraction represents a selected temporal position for the current image relative to the respective reference images, and wherein the selecting the fraction can be independent of actual temporal positions of the respective reference images;

selecting direct mode prediction for one or more macroblocks in the current image; and

finding a motion vector for a co-located macroblock in the future reference image, wherein the fraction facilitates scaling the motion vector for the co-located macroblock in direct mode prediction.

106. (New) The computer-readable storage media of claim 105 wherein the fraction facilitates representation of variable velocity motion in the direct mode prediction.

107. (New) The computer-readable storage media of claim 105 wherein the scaling the motion vector for the co-located macroblock comprises scaling a vertical component and a horizontal component of the motion vector for the co-located macroblock.

108. (New) The computer-readable storage media of claim 105 wherein the scaling the motion vector for the co-located macroblock comprises:

scaling the motion vector for the co-located macroblock by a factor of the fraction, to obtain an implied forward motion vector for a current macroblock of the one or more macroblocks; and

scaling the motion vector for the co-located macroblock by a factor of the fraction minus one, to obtain an implied backward motion vector for the current macroblock.

109. (New) A method of decoding images in a sequence of video images, the method comprising:

receiving and decoding a code to determine a fraction for a current image in the sequence, wherein the current image has a previous reference image and a future reference image, wherein the fraction represents a selected temporal position for the current image relative

to the respective reference images, and wherein the determination of the fraction is independent of actual temporal positions of the respective reference images; and

using the fraction in direct mode prediction for motion compensation of at least one macroblock in the current image.

110. (New) The method of claim 109 wherein the using the fraction in direct mode prediction comprises scaling a motion vector for a co-located macroblock in at least one of the reference images using the fraction.

111. (New) The method of claim 110 wherein the fraction facilitates representation of variable velocity motion in the direct mode prediction.

112. (New) The method of claim 110 wherein the scaling the motion vector for the co-located macroblock comprises scaling a vertical component and a horizontal component of the motion vector for the co-located macroblock.

113. (New) The method of claim 110 wherein the scaling the motion vector for the co-located macroblock comprises:

scaling the motion vector for the co-located macroblock by a factor of the fraction, to obtain an implied forward motion vector for a current macroblock of the at least one macroblock in the current image; and

scaling the motion vector for the co-located macroblock by a factor of the fraction minus one, to obtain an implied backward motion vector for the current macroblock.

114. (New) The method of claim 113 wherein the motion compensation comprises:

addressing a macroblock in the future reference image using the implied forward motion vector;

addressing a macroblock in the previous reference image using the implied backward motion vector; and

predicting the current macroblock using an average of the macroblock in the future reference image and the macroblock in the previous reference image.

115. (New) One or more computer-readable storage media having stored thereon computer-executable instructions for causing one or more computers to perform a method of decoding images in a sequence of video images, the method comprising:

receiving and decoding a code to determine a fraction for a current image in the sequence, wherein the current image has a previous reference image and a future reference image, wherein the fraction represents a selected temporal position for the current image relative to the respective reference images, and wherein the determination of the fraction is independent of actual temporal positions of the respective reference images; and

using the fraction in direct mode prediction for motion compensation of at least one macroblock in the current image.

116. (New) The computer-readable storage media of claim 115 wherein the using the fraction in direct mode prediction comprises scaling a motion vector for a co-located macroblock in at least one of the reference images using the fraction.

117. (New) The computer-readable storage media of claim 116 wherein the fraction facilitates representation of variable velocity motion in the direct mode prediction.

118. (New) The computer-readable storage media of claim 116 wherein the scaling the motion vector for the co-located macroblock comprises scaling a vertical component and a horizontal component of the motion vector for the co-located macroblock.

119. (New) The computer-readable storage media of claim 116 wherein the scaling the motion vector for the co-located macroblock comprises:

scaling the motion vector for the co-located macroblock by a factor of the fraction, to obtain an implied forward motion vector for a current macroblock of the at least one macroblock in the current image; and

scaling the motion vector for the co-located macroblock by a factor of the fraction minus one, to obtain an implied backward motion vector for the current macroblock.

120. (New) The computer-readable storage media of claim 119 wherein the motion compensation comprises:

addressing a macroblock in the future reference image using the implied forward motion vector;

addressing a macroblock in the previous reference image using the implied backward motion vector; and

predicting the current macroblock using an average of the macroblock in the future reference image and the macroblock in the previous reference image.